depositing a silicon-containing material from a silicon source on at least a portion of the substrate, wherein said portion of said substrate is conductive; and

forming the dielectric layer by processing the silicon-containing material in a reactive ambient.

REMARKS

Claims 1-12 and 26-32 are pending in the application. Claims 1-12 and 26-32 have been rejected.

Rejections under §102 over Huang et al.

Claims 1, 2, 5, 6, and 8, 9-12, and 26-30 have been rejected under 35 USC §102 (e) as being anticipated by Huang et al. (Patent No. 6,291,288). Huang et al. teaches a semiconductor fabrication method using a first nitridation process to form a dielectric layer over a bottom electrode. An oxide layer 110 is formed over the first electrode 100. The oxide layer 110 is etched. The remaining oxide layer 110a is converted into a dielectric layer 120 through a nitridation process. A silicon nitride layer 130 is formed over the dielectric layer 120. The silicon nitride layer 130 may have punctures 132 and be rigid. Therefore, the silicon nitride layer 130 and dielectric layer 120 endure a second nitridation process that causes the silicon nitride layer 130 to become a substantially filled silicon nitride layer 130a. The silicon nitride layer 130a and the dielectric layer 120 constitute an ON dielectric structure.

The Examiner states that Huang et al. teaches forming a first conductive layer 100 over at least a portion of the substrate at col. 3, lines 26-33, then depositing a silicon-containing material from a silicon source over the first conductive layer 100. Then, the Examiner asserts that in col. 4, lines 3-15, Huang et al. teaches forming the dielectric layer 130 by processing the deposited silicon-containing material with a reactive agent selected to react with silicon atoms of the deposited silicon containing material.

Applicants respectfully traverse the rejection. The Examiner asserts that a silicon-containing material from a silicon source is **deposited over** the first conductive layer 100

and that this silicon-containing material is processed with a reactive agent to form the dielectric layer. However, an oxide layer 110 is formed over the first conductive layer 100 by exposing the polysilicon substrate to air. See col. 3, lines 30-33. After the oxide layer is etched, then the wafer undergoes a nitridation process which converts the remaining oxide layer 110a into a dielectric layer 120. See col. 3, lines 47-50. Claim 1 has been amended to recite "depositing a silicon-containing material from a silicon source on the first conductive layer." Basis is provided in the Specification at page 14, line 20, which defines "on" as being in contact with a surface of the substrate or layer. Thus, the dielectric layer 120 is not formed from a silicon-containing material **deposited on** the first conductive layer as claimed in claim 1, as amended. Rather, the dielectric layer 120 is formed by exposing polysilicon to air and then applying a nitridation process.

In col. 4, lines 3-16, Huang et al. teaches the subsequent step of forming a layer of silicon nitride 130 over the dielectric layer 120. The silicon nitride is deposited indirectly over the first electrode layer 100. While the silicon nitride layer 130 is deposited **over** the conductive layer 100, it is not deposited **on** the conductive layer 100 as claimed in claim 1, as amended. Huang et al. does not even suggest depositing dielectric layer 120 nor does Huang et al suggest depositing silicon nitride layer 130 on conductive layer 100. Thus, claim 1 as amended is not anticipated by Huang et al. because Huang et al. does not teach a silicon-containing material that is deposited on a conductive layer.

Claim 2 has been rejected by the Examiner under §102 (e) as being anticipated by Huang et al. The Examiner asserts that Huang et al. teaches that the silicon source is silazane at col. 4, lines 5-10. At col. 4, lines 5-10, Huang et al. teach that the use of chlorosilane as the silicon source. This is not a silazane as a silazane contains a Si-N bond. Furthermore, claim 2 depends from claim 1 which is shown above to be novel over Huang et al. Thus, claim 2 is not anticipated by Huang et al.

Claims 5, 6, and 8 have been rejected by the Examiner under §102 (e) as being anticipated by Huang et al. Claim 5 has been amended to provide proper antecedent basis, no new matter has been added. Claims 5, 6, and 8 depend from claim 1 which is

shown above to be novel over Huang et al. Thus, claims 5, 6, and 8 are novel over Huang et al.

√ Claim 9 has been rejected by the Examiner under §102 (e) as being anticipated by Huang et al. Claim 9 as recites "a silicon-containing material from a silazane source." As stated above in the argument for claim 2, Huang et al. Huang et al. teach that the use of chlorosilane as the silicon source, **not a** silazane as a silazane contains a Si-N bond. Thus, claim 9 is novel over Huang et al. Furthermore, Huang et al. does not even suggest using a silazane as the silicon source. Claims 10 and 11 depend from claim 9, therefore, claims 10 and 11 are also novel over Huang et al.

√ Claim 12 has been rejected under § 102 (e) as being anticipated by Huang et al. Claim 12, as amended, recites "depositing a silicon-containing material from a self limiting silicon source on at least a portion of the substrate, wherein said portion of said substrate is conductive." Basis is provided in the Specification at page 14, line 20, which defines "on" as being in contact with a surface of the substrate or layer, at page 15, lines 1-3 and page 15, lines 10-12. As stated above, Huang et al. does not teach depositing a silicon-containing material on a conductive layer. Rather, Huang et al. teaches exposing a polysilicon substrate to air to form an oxide layer 110. After the oxide layer 110 undergoes a nitridation process, forming dielectric layer 120, a silicon nitride layer is deposited onto the dielectric layer 120. This is not the invention as recited in claim 12, as amended. Therefore, claim 12 is novel over Huang et al. Furthermore, Huang et al. does not even suggest the invention as recited in claim 12 as amended.

Claim 26 has been rejected under § 102 (e) as being anticipated by Huang et al. Claim 26 has been amended to recite "depositing a silicon-containing material from a silicon source on at least a portion of the substrate, wherein said portion of said substrate is conductive." Basis is provided in the Specification at page 14, line 20, which defines "on" as being in contact with a surface of the substrate or layer, at page 15, lines 1-3 and page 15, lines 10-12. As stated above, Huang et al. does not teach depositing a silicon-containing material on a conductive layer. Rather, Huang et al. teaches exposing a

polysilicon substrate to air to form an oxide layer 110. After the oxide layer 110 undergoes a nitridation process, forming dielectric layer 120, a silicon nitride layer is deposited onto the dielectric layer 120. This is not the invention as recited in claim 26, as amended. Therefore, claim 26 is novel over Huang et al. Claims 27-30 depend from claim 26, therefore, claims 27-30 are novel over Huang et al. Furthermore, Huang et al. does not even suggest the invention as recited in claim 26 as amended.

<u>Rejections under §102 over Chew et al.</u>

Claims 31-32 have been rejected under 35 USC § 102(e) as being unpatentable over Chew et al. (US Patent No. 6,258,653). Chew et al. teaches a capacitor where tantalum oxide reacts with a silicon nitride layer 14 grown on a silicon surface 12 to form the dielectric layer 16. The silicon nitride layer 14 is grown using a high density plasma of nitrogen that reacts with the exposed silicon surface. See col. 3, lines 37-40.

The Examiner asserts that vapor depositing a silicon-containing material comprising a silazane over at least a portion of the substrate is taught at col. 3, lines 55-63. Applicants can find no such teaching. Chew et al. teaches the use of a silane, not a silazane. Then at col. 4, lines 15-30 the dielectric layer 14 is formed by rapidly thermally nitridizing the deposited silicon containing material in a nitridizing agent. Applicants respectfully disagree with the Examiner. Chew et al. teach forming the silicon nitride layer 14 by using a nitridation step. See col. 4, line 30. In fact, the nitridation step is used when the conductive surface contains no silicon. See col. 4, lines 25-27. The silicon nitride layer 14 is then in turn reacted with tantalum oxide to form the dielectric layer 16. Thus, there is no teaching or suggestion in Chew et al. to form the dielectric layer as claimed in claim 31. Claim 32 depends from claim 31, therefore claims 31-32 are novel and nonobvious over Chew et al.

<u>Rejections under § 103(a)</u>

Claims 3, 4, and 7 have been rejected under 35 USC § 103(a) as being unpatentable over Huang et al. The Examiner states that it would have been obvious to utilize the claimed silicon-sources because the sources are commonly used to form a

dielectric layer. As stated above, an oxide layer 110 is formed over the first conductive layer 100 by exposing the polysilicon substrate to air. See col. 3, lines 30-33. After the oxide layer is etched, then the wafer undergoes a nitridation process which converts the remaining oxide layer 110a into a dielectric layer 120. See col. 3, lines 47-50. In col. 4, lines 3-16, Huang et al. teaches the subsequent step of forming a layer of silicon nitride 130 over the dielectric layer 120. The silicon nitride is deposited indirectly over the first electrode layer 100. While the silicon nitride layer 130 is deposited over the conductive layer 100, it is not deposited on the conductive layer 100.

There is no suggestion or motivation in Huang et al. to deposit a silicon-containing material on a conductive layer as recited in claim 1, as amended, thus claim 1 is nonobvious over Huang, et al. Claims 3, 4, and 7 depend from claim 1 therefore, claims 3, 4, and 7 are nonobvious over Huang et al.

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In CONCLUSION

Applicants respectfully submit that, in view of the above remarks, the application is now in condition for allowance. Early notification of allowable subject matter is respectfully solicited.

Respectfully submitted,
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APPENDIX

In the Specification

At page 1, line 1, please amend the title to read:

--"METHOD OF FORMING A DIELECTRIC LAYER [AND SEMICONDUCTOR DEVICE INCORPORATING THE SAME]"--

At page 25, please amend the Abstract to read:

"[Semiconductor devices and methods for fabricating semiconductor devices are disclosed. The methods and devices utilize a silicon-containing dielectric layer.] Methods for fabricating a dielectric layer are provided. In one embodiment, a silicon-containing material is deposited on a substrate. The deposited material is processed with a reactive agent to react with silicon atoms of the deposited material to form the dielectric layer. The silicon-containing dielectric layer can allow for improved or smaller semiconductor devices. Improved or smaller semiconductor devices may be accomplished by reducing leakage and increasing the dielectric constant."

In the Claims

1. (Amended) A method of forming a dielectric layer on a semiconductor device comprising:

providing a substrate having at least one semiconductor layer;

forming a first conductive layer over at least a portion of the substrate;

depositing a silicon-containing material from a silicon source [over] on the first conductive layer;

forming the dielectric layer by processing the deposited silicon-containing material with a reactive agent selected to react with silicon atoms of the deposited silicon-containing material; and

forming a second conductive layer over the dielectric layer.

5. (Amended) The method of claim 1, wherein the reactive [ambient] agent is selected from the group comprising NH_3, N_2, O_2, O_3, [N_20] N_2O and NO.

12. (Amended) A method of forming a dielectric layer comprising:

providing a substrate having at least one semiconductor layer;

vapor depositing a silicon-containing material from a self limiting silicon source [over] on at least a portion of the substrate, wherein said portion of said substrate is conductive; and

forming the dielectric layer by processing the silicon-containing material in a reactive ambient at a processing temperature, a processing time and a processing pressure selected to result in a desired dielectric constant and leakage characteristics.

26. (Amended) A method of forming a dielectric layer comprising:

providing a substrate having at least one semiconductor layer;

depositing a silicon-containing material from a silicon source [over] on at least a portion of the substrate, wherein said portion of said substrate is conductive; and

forming the dielectric layer by processing the silicon-containing material in a reactive ambient.